Minarik Automation & Control

# MM20000 Series

**Model:**

MM21035B

SCR, Adjustable Speed Drives
for DC Brush Motors

User's Manual

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Printed in the United States of America.

# Safety Warnings

- This symbol ⚠ denotes an important safety tip or warning. **Please read these instructions carefully** before performing any of the procedures contained in this manual.

- **DO NOT INSTALL, REMOVE, OR REWIRE THIS EQUIPMENT WITH POWER APPLIED.** Have a qualified electrical technician install, adjust and service this equipment. Follow the National Electrical Code and all other applicable electrical and safety codes, including the provisions of the Occupational Safety and Health Act (OSHA), when installing equipment.

- Reduce the chance of an electrical fire, shock, or explosion by proper grounding, over-current protection, thermal protection, and enclosure. Follow sound maintenance procedures.

⚠ **It is possible for a drive to run at full speed as a result of a component failure.** Minarik strongly recommends the installation of a master switch in the main power input to stop the drive in an emergency.

**Circuit potentials are at 115 VAC above earth ground.** Avoid direct contact with the printed circuit board or with circuit elements to prevent the risk of serious injury or fatality. Use a non-metallic screwdriver for adjusting the calibration trimpots. Use approved personal protective equipment and insulated tools if working on this drive with power applied.

# Contents

**Specifications** 1

**Dimensions** 2

**Installation** 3
- Drive mounting . . . 3
- Wiring . . . 4
  - Shielding guidelines . . . 5
- Heat sinking . . . 6
- Line fusing . . . 6
- Connections . . . 7
  - Motor connections . . . 7
  - Power lead connections . . . 8
  - Line fuse connections . . . 8

**Operation** 11
- Before applying power . . . 11
- Startup and shutdown . . . 11
  - To shut down the drive: . . . 11
  - Reversing . . . 12
- Starting and Stopping Methods . . . 12
  - Line starting and stopping . . . 12
  - Dynamic braking . . . 13
  - INHIBIT mode . . . 15

**Calibration** 16
- Calibration procedure . . . 18
  - MINIMUM SPEED (MIN SPD) . . . 18
  - MAXIMUM SPEED (MAX SPD) . . . 19
  - RATE . . . 19
  - REGULATION (IR COMP) . . . 20
  - TORQUE LIMIT (TORQUE) . . . 21

**Application Notes** 22
- Reversing with dynamic braking . . . 22

**Troubleshooting** 23
- Before troubleshooting . . . 23
- Replacement Parts . . . 26

**Unconditional Warranty** **inside back cover**

# Illustrations

Figure 1. Dimensions . . . . . .2
Figure 2. Power, Fuse and Motor Connections (No Choke/Capacitor Filter Installed) . . . . . .9
Figure 3. Power, Fuse and Motor Connections (Choke/Capacitor Filter Installed) . . . . . .10
Figure 4. Dynamic Brake Connection . . . . . .14
Figure 5. Inhibit Terminals With Optional Switch Installation . . . . . .15
Figure 6. Calibration Trimpot Layout . . . . . .17
Figure 7. Reversing Circuit Connection . . . . . .22

# Tables

Table 1. Recommended Line Fuse Chart . . . . . .6
Table 2. Recommended Dynamic Brake Resistor Sizes . . . . . .13
Table 3. Replacement Parts . . . . . .26

# Notes

# Specifications

| Model | AC Line Voltage | Max. AC Input Current | Max. DC Armature Current | HP Range | Style |
|---|---|---|---|---|---|
| MM21035B | 115 | 8 | 5 | 1/8 - 1/2 | Chassis |

| | |
|---|---|
| AC Line Voltage Tolerance | -5%, + 10%, 50/60 Hz, single phase |
| Armature Voltage Range | 0 – 90 VDC |
| Accel. Time Range | 0.5 – 11 seconds |
| Decel. Time Range | coast to a stop – 13 seconds |
| Input Impedance (S1 to S2) | 100K ohms |
| Load Regulation | 1% base speed or better |
| Vibration | 0.5G max (0 – 50 Hz)<br>0.1G max (>50 Hz) |
| Ambient Temp. Range | 10ºC - 55ºC |
| Weight | 0.5 lb |

# Dimensions

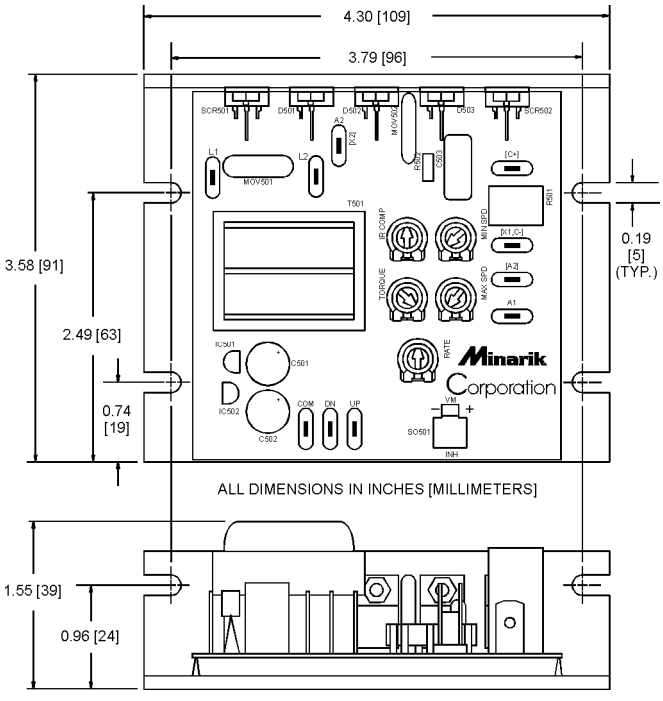



**Figure 1. Dimensions**

# Installation

## Drive mounting

**Warning**

**Do not install, rewire, or remove this control with power applied.** Doing so may cause fire or serious injury. Make sure you have read and understood the Safety Warnings on page i before attempting installation.

The chassis must be earth grounded. Use a star washer beneath the head of at least one of the mounting screws to penetrate the anodized chassis surface and to reach bare metal.

- Drive components are sensitive to electrostatic fields. Avoid direct contact with the circuit board. Hold drive by the chassis only.
- Protect the drive from dirt, moisture, and accidental contact.
- Provide sufficient room for access to the spade terminals and calibration trimpots.
- Mount the drive away from heat sources. Operate the drive within the specified ambient operating temperature range.
- Prevent loose connections by avoiding excessive vibration of the drive.
- Mount drive with its board in either a horizontal or vertical plane. Six 0.19 in. (5 mm) wide slots in the chassis accept #8 pan head screws. Fasten either the large base or the narrow flange of the chassis to the subplate.

## Wiring

**Warning**

Do not install, remove, or rewire this equipment with power applied. Failure to heed this warning may result in fire, explosion, or serious injury.

Circuit potentials are at 115 VAC above ground. To prevent the risk of injury or fatality, avoid direct contact with the printed circuit board or with circuit elements.

Do not disconnect any of the motor leads from the drive unless power is removed or the drive is disabled. Opening any one motor lead may destroy the drive.

Use 18-24 AWG wire for speed adjust potentiometer wiring. Use 14–16 AWG wire for AC line (L1, L2), field (F1, F2) and motor (A1 and A2) wiring.

## Shielding guidelines

**Warning**

Under no circumstances should power and logic leads be bundled together. Induced voltage can cause unpredictable behavior in any electronic device, including motor controls.

As a general rule, Minarik recommends shielding of all conductors.

If it is not practical to shield power conductors, Minarik recommends shielding all logic-level leads. If shielding logic leads is not practical, the user should twist all logic leads with themselves to minimize induced noise.

It may be necessary to earth ground the shielded cable. If noise is produced by devices other than the drive, ground the shield at the drive end. If noise is generated by a device on the drive, ground the shield at the end away from the drive. Do not ground both ends of the shield.

If the drive continues to pick up noise after grounding the shield, it may be necessary to add AC line filtering devices, or to mount the drive in a less noisy environment.

## Heat sinking

MM21035B series drives contain sufficient heat sinking in their basic configurations. No additional heat sinking is necessary.

## Line fusing

Minarik drives require an external fuse for protection. Use fast acting fuses rated for 250 VAC or higher, and approximately 150% of the maximum armature current. Table 1 lists the recommended line fuse sizes.

**Table 1. Recommended Line Fuse Sizes**

| 90 VDC Motor Horsepower | Max. DC Armature Current (amps) | AC Line Fuse Size (amps) |
|---|---|---|
| 1/8 | 1.3 | 3 |
| 1/6 | 1.7 | 3 |
| 1/4 | 2.5 | 5 |
| 1/3 | 3.5 | 8 |
| 1/2 | 5.0 | 10 |

Minarik Corporation offers two fuse kits: part number 050-0066 (1 - 5A Fuse Kit) and 050-0071 (5 - 15A Fuse Kit). See Replacement Parts (page 23) for fuse kit contents.

# Connections

**Warning**

Do not connect this equipment with power applied. Failure to heed this directive may result in fire or serious injury.

Minarik strongly recommends the installation of a master power switch in the voltage input line. The switch contacts should be rated at a minimum of 200% of motor nameplate current and 250 volts.

Connect the power input leads, external line fuse(s) and DC motor to the drive's printed circuit board (PCB) as shown in Figure 2 (page 9) if no choke capacitor filter is installed. Connect the drive as shown in Figure 3 (page 10) when using a choke/capacitor filter.

## Motor connections

Minarik drives supply motor voltage from A1 and A2 terminals. It is assumed throughout this manual that, when A1 is positive with respect to A2 , the motor will rotate clockwise (CW) while looking at the output shaft protruding from the front of the motor. If this is opposite of the desired rotation, simply reverse the wiring of A1 and A2 with each other.

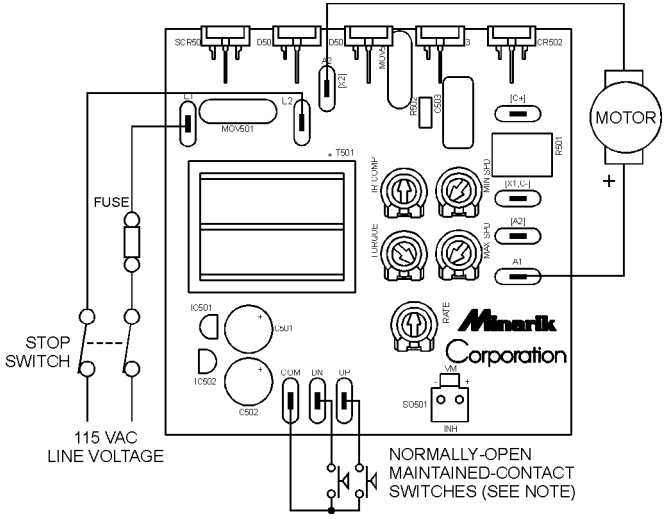
Connect a DC motor to PCB terminals A1 and A2 as shown in Figure 2. If using a choke/capacitor filter, connect the motor to PCB terminals A1 and [A2] as shown in Figure 3 (page 10). **Ensure that the motor voltage rating is consistent with the drive's output voltage.**

## Power lead connections

Connect the AC line power leads to PCB terminals L1 and L2, or to a double-throw, single-pole master power switch (recommended).

## Line fuse connections

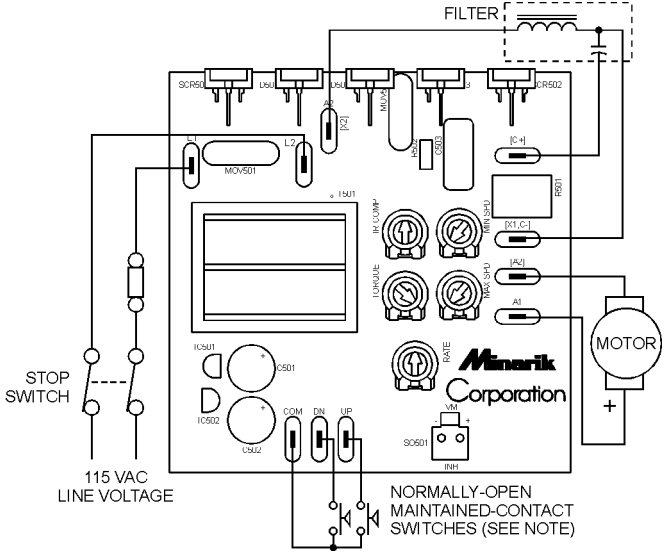
Wire an external line fuse between the stop switch (if installed) and the L1 terminal. An additional line fuse should be installed on L2 if the input voltage is 230 VAC. The line fuse(s) should be rated at 250 volts and 150 - 200% of maximum motor nameplate current. Refer to the line fuse chart on page 6 for replacement line fuse sizes.




**NOTE:**

YOU MAY ALSO USE ISOLATED TTL LOGIC SWITCHING IN PLACE OF UP/DN SWITCHES.

**Figure 2. Power, Fuse and Motor Connections (No Choke/Capacitor Filter Installed)**




**NOTE:**

YOU MAY ALSO USE ISOLATED TTL LOGIC SWITCHING IN PLACE OF UP/DN SWITCHES.

**Figure 3. Power, Fuse and Motor Connections (Choke/Capacitor Filter Installed)**

# Operation

**Warning**

Dangerous voltages exist on the drive when it is powered. BE ALERT. High voltages can cause serious or fatal injury.

## Before applying power

- Verify that no conductive material is present on the printed circuit board.
- Verify that the AC supply is properly balanced.

## Startup and shutdown

1. Apply AC line voltage.
2. Press and hold the UP or DOWN pushbutton. The motor will accelerate in the desired direction at a rate controlled by the RATE trimpot.
3. Release the UP or DOWN pushbutton. The motor will decelerate to zero (or minimum) speed at a rate controlled by the RATE trimpot.

### To shut down the drive:

Remove AC line voltage from the drive.

### Reversing

Refer to ***Application Notes*** (page 22) for reversing options, or contact your Minarik sales representative.

## Starting and Stopping Methods

**Warning**

For frequent starts and stops, use inhibit mode (shorting VM+ to VM-) or dynamic braking. Do not use any of these methods for emergency stopping. They may not stop a drive that is malfunctioning. Removing AC line power (both L1 and L2) is the only acceptable method for emergency stopping.

**NOTE:** Minarik strongly recommends the installation of an emergency stop switch. The switch contacts should be rated at a minimum of 250 volts and 200% of maximum motor current.

### Line starting and stopping

Line starting and stopping (applying and removing AC line voltage) is recommended for starting and stopping in emergency situations only. It is not recommended for frequent starting and stopping. When AC line voltage is applied to the drive, the motor accelerates to minimum speed (set by the MIN SPD trimpot). When AC line voltage is removed, the motor coasts to a stop.

## Dynamic braking

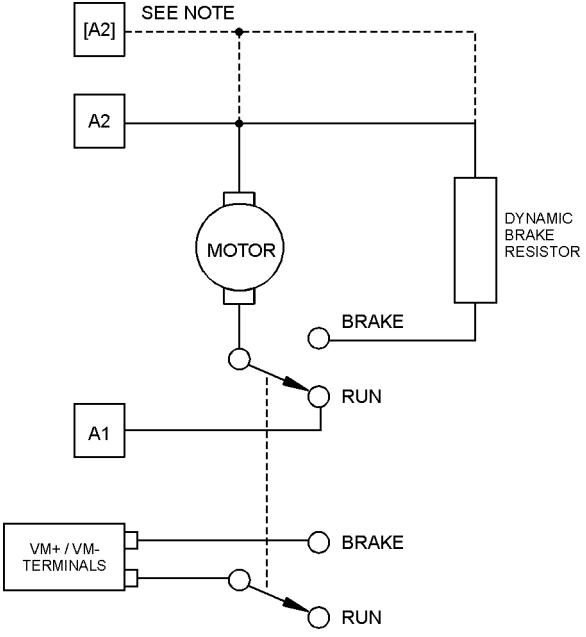
**Warning**

Wait for the motor to completely stop before switching it back to RUN. This will prevent high armature currents from damaging the motor or drive.

Dynamic braking may be used to rapidly stop a motor (Figure 4, page 14). For the RUN/BRAKE switch, use a double-pole, double-throw switch rated for at least the maximum DC armature voltage and maximum braking current.

**Table 2. Recommended Dynamic Brake Resistor Sizes**

| Motor Armature Current Rating | Minimum Dynamic Brake Resistor Value | Minimum Dynamic Brake Resistor Wattage |
|---|---|---|
| Less than 2 ADC | 1 ohm | 1W |
| 2–3 ADC | 5 ohm | 5W |
| 3–5 ADC | 10 ohm | 10W |
| 5–10 ADC | 20 ohm | 20W |




**NOTE:** IF USING CHOKE/CAPACITOR FILTER, CONNECT MOTOR ARMATURE TO A1 AND [A2] INSTEAD OF A1 AND A2.

**Figure 4. Dynamic Brake Connection**

## INHIBIT mode

**Warning**

Do not use inhibit mode for emergency stopping. It may not stop a drive that is malfunctioning. Removing AC line power (both L1 and L2) is the only acceptable method for emergency stopping.

Short the VM+ and VM- pins together to inhibit the motor, which will coast to the speed set by the MIN SPD trimpot. Removing the short causes the motor to accelerate to set speed.

An option is to connect a single-pole, single-throw switch between the inhibit pins. Close the switch to inhibit the drive; open the switch to accelerate to set speed. See Figure 5 for inhibit mode switch connections.

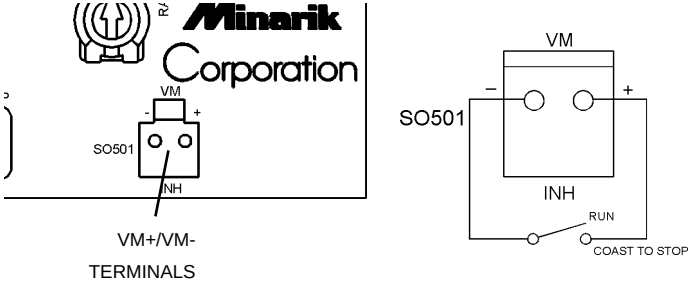



**Figure 5. Inhibit Terminals With Optional Switch Installation**

# Calibration

**Warning**

Dangerous voltages exist on the drive when it is powered. When possible, disconnect the voltage input from the drive before adjusting the trimpots. If the trimpots must be adjusted with power applied, use insulated tools and the appropriate personal protection equipment. BE ALERT. High voltages can cause serious or fatal injury.

MM21035B Series drives have five user-adjustable trimpots. Each drive is factory calibrated to its maximum current rating. Readjust the calibration trimpot settings to accommodate lower current rated motors. See Figure 6 for trimpot location.

All adjustments increase with CW rotation and decrease with CCW rotation. Use a non-metallic screwdriver for calibration. Each trimpot is identified on the printed circuit board.

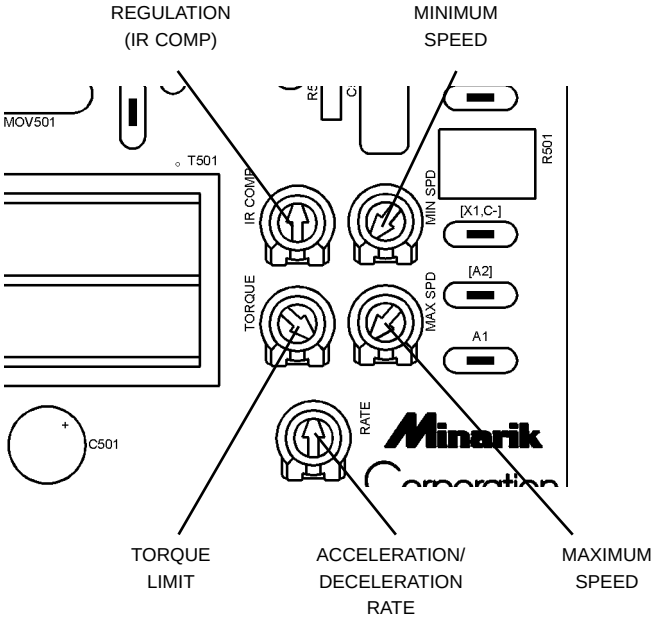



**Figure 6. Calibration Trimpot Layout**

# Calibration procedure

Calibrate the drive using the following procedure:

1. Set the MIN SPD and MAX SPD trimpots to minimum (full CCW).
2. Set the TORQUE trimpot to maximum (full CW).
3. Set the IR COMP and RATE trimpots to the 12 o'clock position.
4. Apply power to the drive.
5. Calibrate the trimpots as follows:

## MINIMUM SPEED (MIN SPD)

The MIN SPD setting determines the motor speed when power is applied, but neither the UP nor DOWN pushbutton is pressed. It is factory set for zero speed.

To calibrate, set the MIN SPD trimpot full CCW. Apply power to the drive. Adjust the MIN SPD trimpot until the desired minimum motor speed is reached.

## MAXIMUM SPEED (MAX SPD)

The MAX SPD setting determines the maximum motor speed when either the UP or DOWN pushbutton is pressed and held. It is factory set for maximum rated speed.

To calibrate, set the MAX SPD trimpot full CCW. Press and hold the UP or DOWN pushbutton. Adjust the MAX SPD trimpot until the desired maximum motor speed is reached.

## RATE

The RATE setting determines the time the motor takes to ramp to a higher speed in either direction. RATE is factory set for the fastest acceleration time (full CCW).

To set the acceleration time:

1. Apply power to the drive. The motor should run at minimum speed.
2. Press and hold the UP or DOWN pushbutton and measure the time it takes the motor to go from minimum to maximum speed.
3. If the time measured in step 2 is not the desired acceleration time, turn the RATE trimpot CW for a slower acceleration time, or CCW for a faster acceleration time. Repeat steps 1 through 3 until the acceleration time is correct.

## REGULATION (IR COMP)

The IR COMP trimpot setting determines the degree to which motor speed is held constant as the motor load changes. It is factory set for optimum motor regulation.

To calibrate IR COMP:

1. Turn the IR COMP trimpot full CCW.
2. Press and hold the UP or DOWN button until the motor runs at midspeed without load (for example, 900 RPM for an 1800 RPM motor). A hand held tachometer may be used to measure motor speed.
3. Load the motor armature to its full load armature current rating. The motor should slow down.
4. While keeping the load on the motor, rotate the IR COMP trimpot until the motor runs at the speed measured in step 2.

## TORQUE LIMIT (TORQUE)

**Warning**

Although TORQUE LIMIT is set to 120% of motor nameplate current rating, continuous operation beyond that rating may damage the motor. If you intend to operate beyond the rating, contact your Minarik representative for assistance.

The TORQUE setting determines the maximum torque for accelerating and driving the motor. TORQUE is factory set at 120% of maximum drive current. You must recalibrate the TORQUE setting if using a lower current motor.

1. With no power applied to the drive, connect a DC ammeter in series with the motor armature.
2. Set the CURRENT LIMIT trimpot to full CCW.
3. Carefully lock the motor armature. Ensure that the motor is firmly mounted.
4. Apply line power. The motor should be stopped.
5. Press and hold the UP or DOWN pushbutton. The motor should remain stopped.
6. While holding the pushbutton, slowly rotate the TORQUE trimpot clockwise (CW) until the ammeter reads 120% of maximum motor armature current.
7. Release the pushbutton.
8. Remove power from the drive.
9. Remove the lock from the motor shaft.
10. Remove the ammeter in series with the motor armature.

# Application Notes

## Reversing with dynamic braking

Always use dynamic braking when reversing the motor direction (Figure 7). Use a three pole, three position switch rated for at least the maximum DC armature voltage and maximum braking current. Wait for the motor to stop completely before switching it to either the forward or reverse direction.

Refer to *Dynamic Braking* (page 13) for more information on dynamic brake resistor sizes.

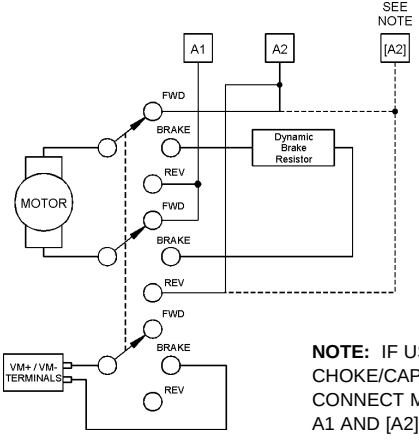



**Figure 7. Reversing Circuit Connection**

# Troubleshooting

**Warning**

Dangerous voltages exist on the drive when it is powered. When possible, disconnect the drive while troubleshooting. High voltages can cause serious or fatal injury.

## Before troubleshooting

Perform the following steps before starting any procedure in this section:

- Disconnect AC line voltage from the drive.
- Check the drive closely for damaged components.
- Check that no conductive or other foreign material has become lodged on the printed circuit board.
- Verify that every connection is correct and in good condition.
- Verify that there are no short circuits or grounded connections.
- Check that the drive's rated armature outputs are consistent with the motor ratings.

For additional assistance, contact your local Minarik distributor, or the factory direct:
(800) MINARIK (phone) or (800) 394-6334 (fax).

| Symptom | Possible Causes | Suggested Solutions |
|---|---|---|
| Line fuse blows | 1. Line fuses are the wrong size.<br><br>2. Motor cable or armature is shorted to ground.<br><br>3. Nuisance tripping caused by a combination of ambient conditions and high-current spikes. | 1. Check that line fuses are proper size.<br><br>2. Check motor cable and armature for shorts.<br><br>3. Add a blower to cool the drive components; decrease TORQUE settings, **or** resize motor and drive for actual load demand, **or** check for incorrectly aligned mechanical components or “jams”. See page 21 for information on adjusting the TORQUE trimpot. |
| Line fuse does not blow, but the motor does not run | 1. UP/DN pushbutton connections are open.<br><br>2. Drive is overloaded.<br><br>3. Drive is not receiving AC line voltage.<br><br>4. Motor is not connected. | 1. Check pushbutton connections.<br><br>2. Verify that the motor is not jammed. Increase TORQUE setting (page 21).<br><br>3. Apply AC line voltage to L1 and L2.<br><br>4. Connect motor to A1 and A2. |

| Symptom | Possible Causes | Suggested Solutions |
|---|---|---|
| Motor runs too fast at maximum speed setting | 1. MIN SPD and MAX SPD settings are too high. | 1. Recalibrate MIN SPD (page 18) and MAX SPD (page 19). |
| Motor runs too slow or too fast | 1. MIN SPD and MAX SPD are not calibrated. | 1. Recalibrate MIN SPD (page 18) and MAX SPD (page 19). |
| Motor will not reach the desired speed. | 1. MAX SPD setting is too low.<br>2. IR COMP setting is too low.<br>3. Motor is overloaded. | 1. Increase MAX SPD setting (page 19).<br>2. Increase IR COMP setting (page 20).<br>3. Check motor load. Resize the motor if necessary. |
| Motor pulsates or surges under load | 1. IR COMP is set too high.<br>2. Control is in current limit mode. | 1. Adjust the IR COMP setting slightly CCW until the motor speed stabilizes (page 20).<br>2. Check that motor is of sufficient horsepower and amperage. |

# Replacement Parts

Replacement parts are available from Minarik Corporation and its distributors for this drive series.

### Table 3. Replacement Parts

| Model No. | Symbol | Description | Minarik® P/N |
|---|---|---|---|
| **MM21035A** | C501-502 | 220 uF, 35 VDC Capacitor | 011-0027 |
| | D506-508 | D8020L High-power Diode | 071-0039 |
| | SCR501–502 | S8020L High-power SCR | 072-0043 |
| | R531 | 0.01 Ohm, 5W Resistor | 032-0065 |
| | T501 | ST-3-3109 115VAC Transformer | 230-0083 |
| | | Chassis | 222-0079 |
| **MM22035A** | Same as MM21011A except: | | |
| | T501 | DST-2-28 230 VAC Transformer | 230-0061 |

**FUSE KIT CONTENTS**

**1 - 5A FUSE KIT (050-0066)**

| | |
|---|---|
| 2 EA 1 AMP 3AG FAST-ACTING FUSE | 050-0042 |
| 2 EA 1-1/2 AMP 3AG FAST-ACTING | 050-0026 |
| 2 EA 3 AMP 3AG FAST-ACTING FUSE | 050-0021 |
| 2 EA 5 AMP 3AG FAST-ACTING FUSE | 050-0022 |

**5 - 15A FUSE KIT (050-0071)**

| | |
|---|---|
| 2 EA 5 AMP 3AG FAST-ACTING FUSE | 050-0022 |
| 2 EA 8 AMP 3AG FAST-ACTING | 050-0059 |
| 2 EA 10 AMP 3AG FAST-ACTING FUSE | 050-0024 |
| 2 EA 15 AMP 3AG FAST-ACTING FUSE | 050-0018 |

# Notes

# Notes

# Unconditional Warranty

## A. Warranty

Minarik Corporation (referred to as "the Corporation") warrants that its products will be free from defects in workmanship and material for twelve (12) months or 3,000 hours, whichever comes first, from date of manufacture thereof. Within this warranty period, the Corporation will repair or replace, at its sole discretion, such products that are returned to Minarik Corporation, 901 East Thompson Avenue, Glendale, CA 91201-2011 USA.

This warranty applies only to standard catalog products, and does not apply to specials. Any returns for special controls will be evaluated on a case-by-case basis. The Corporation is not responsible for removal, installation, or any other incidental expenses incurred in shipping the product to and from the repair point.

## B. Disclaimer

The provisions of Paragraph A are the Corporation's sole obligation and exclude all other warranties of merchantability for use, express or implied. The Corporation further disclaims any responsibility whatsoever to the customer or to any other person for injury to the person or damage or loss of property of value caused by any product that has been subject to misuse, negligence, or accident, or misapplied or modified by unauthorized persons or improperly installed.

## C. Limitations of Liability

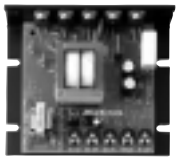
In the event of any claim for breach of any of the Corporation's obligations, whether express or implied, and particularly of any other claim or breech of warranty contained in Paragraph A, or of any other warranties, express or implied, or claim of liability that might, despite Paragraph B, be decided against the Corporation by lawful authority, the Corporation shall under no circumstances be liable for any consequential damages, losses, or expense arising in connection with the use of, or inability to use, the Corporation's product for any purpose whatsoever.

An adjustment made under warranty does not void the warranty, nor does it imply an extension of the original 12-month warranty period. Products serviced and/or parts replaced on a no-charge basis during the warranty period carry the unexpired portion of the original warranty only.

If for any reason any of the foregoing provisions shall be ineffective, the Corporation's liability for damages arising out of its manufacture or sale of equipment, or use thereof, whether such liability is based on warranty, contract, negligence, strict liability in tort, or otherwise, shall not in any event exceed the full purchase price of such equipment.

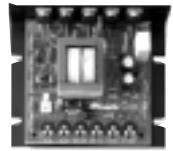
Any action against the Corporation based upon any liability or obligation arising hereunder or under any law applicable to the sale of equipment or the use thereof, must be commenced within one year after the cause of such action arises.

# Other drives from Minarik Corporation:

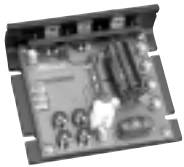


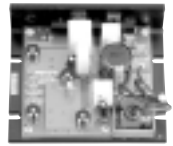
PCM20000 Series

DLC500



MM23000 Series





XP Series
(AC or DC Input)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